DOCUMENT RESUME

ED 160 180 PS 009 720

AUTHOR Stone, Barbara Prince; And Others
TITLE An Analysis of Active Rehearsal in Children's Memory.
PUB DATE Aug 77
NOTE 19p.; Paper presented at the Annual Meeting of the American Psychological Association (85th, San Francisco, California, August 26-30, 1977)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Advance Organizers; *Age Differences; Cues; Elementary School Students; *Learning Processes; *Mediation Theory; *Memorizing; Memory; *Recall (Psychological); Research
IDENTIFIERS *Rehearsal Strategies

ABSTRACT

This paper presents a developmental study of the effects of item rehearsal on children's short term memory. Two experiments are discussed. The first, involving second and sixth grade children, concerned the relationship between item retrieval ability and rehearsal strategies in item recall. The design of the experiment involved varying the visual availability of items prior to recall and varying instructions for active rehearsal. Active rehearsal instructions significantly improved the recall of second grade children, most significantly in the item-available condition. Item availability did not significantly affect the performance of the sixth grade children. These results suggest that item retrieval may not be an important component of active rehearsal. The second experiment concerned the relationship between rehearsal activity and the organizational structure of the recall material. Subjects were third and sixth grade children. This experiment involved sorting words into semantically related, story related, or random groups. Item availability was also varied. Results from this study suggest that active rehearsal may assist in the development of an organizational structure, and that once this structure is attained or developed by the subject, recall is constant regardless of age of subject. Results from both experiments emphasize the importance of rehearsal strategies in short term memory processing. (BD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ED160180

An Analysis of Active Rehearsal in Children's Memory

Barbara Prince Stone
University of North Carolina at Chapel Hill

Mary J. Naus
Haverford College

and

Peter A. Ornstein
University of North Carolina at Chapel Hill

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Peter A. Ornstein

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

PS 009720

Draft of a paper presented at the meetings of the American Psychological Association, August, 1977.

The recall superiority of older children is thought to be due to their use of active rehearsal techniques (Ornstein, Naus, & Liberty, 1975). Older children spontaneously rehearse more actively (by repeating more to-be-remembered words together) than do younger children. The present research examined some factors which may contribute to the effectiveness of these rehearsal strategies. One issue addressed is that of retrieval in rehearsal. Active rehearsal involves retrieving earlier list items to be rehearsed as each new item is presented. Is this strategy effective because it provides practice in the retrieval that is required on the recall trial? A second issue addressed is that of the relationship between organizational patterns and rehearsal activity, both before and after a stable organizational criterion has been attained.

In an overt rehearsal free recall situation, subjects are presented with a list of to-be-remembered words. While learning the list, the subject is asked to rehearse or practice aloud during the intervals between presentation of the items. After all items have been presented, the subject is asked to recall as many of the items as possible, in any order. Recall findings from a typical experiment are presented in the first slide. These data represent recall as a function of serial position for third, sixth, and eighth grade subjects from a study by Ornstein, Naus, and Liberty. Note that there are minimal age differences in the recall of the last few list items

- - - - - - - -

slide 1

- - - - - - - -

(i.e., the recency effect). In contrast, there are marked differences in the recall of the initial and middle items (i.e., in the pre-recency items). Findings such as these are typical of the literature on children's memory;

the major age differences seem to be in the recall of beginning list items, those typically thought to be more deeply encoded than the words at the end of the list.

Previous research suggests that developmental changes in rehearsal skills may underlie, to a considerable extent, these age-related differences in recall. Examination of the rehearsal tape-recorded as subjects attempt to commit a list of words to memory indicates that children of different ages approach the task in quite different ways. You can get a feeling for these differences in rehearsal by examining the next slide which presents sample

- - - - - - - -

slide 2

- - - - - - - -

rehearsal sets, i.e., the words rehearsed when a given item was presented, for typical eighth and third grade subjects. Note that as additional items are introduced into the list, the eighth grader rehearses by intermixing several items. The third grader, in contrast, tends to rehearse the item that is currently being presented only, or that item in combination with one other item.

In the next slide, data such as these are summarized for all of the

- - - - - - - -

slide 3

- - - - - - - -

subjects in Ornstein, Naus and Liberty's experiment. This is a plot of the number of different or unique items present in a rehearsal set, i.e., the number of different items rehearsed together, as a function of serial position, for subjects of three ages. The differences between the asymptotes for the three age groups are very striking. Whereas the sixth and eighth

graders rehearse between 4 and 4.5 items together over the bulk of the rehearsal sets, the third graders rehearse only 2.5 items. Thus, while the older subjects intermix a relatively large number of items, the third graders tend to rehearse the items currently being presented in a very restricted context.

The above findings demonstrate in a descriptive manner, a relationship between rehearsal activity and recall. Training experiments have provided experimental support for this relationship. For example, Ornstein, Naus, and Stone (1977) instructed second and sixth graders to rehearse list items singly or in minimal combination with others. These children recalled few items from the pre-recency portions of the list. In contrast, subjects who intermixed several items together in an active rehearsal strategy, demonstrated superior recall of these items. The results indicate that children as young as the second grade can modify their rehearsal strategy according to the instructions of the experimenter, and that recall varies as a function of these changes in rehearsal. It should be noted, however, that although the second graders' performance was affected by the instructional manipulation, neither their rehearsal activity nor their recall level was equivalent to that of actively rehearsing sixth graders.

One issue arising from this training study concerns factors responsible for the effectiveness of active rehearsal. Active rehearsal involves retrieving early list items to be rehearsed as each new item is presented. This retrieving of items for rehearsal seems similar, in some sense, to the retrieval that is required when subjects recall the items in the test phase of the task. Is it the case that rehearsal is effective because of this experience in continual retrieving? On the other hand, it might be that the act of retrieving items for rehearsal is less important than the consequences of such retrieval, namely, having several items available to be

rehearsed. A parallel issue arising from the Ornstein, Naus, and Stone experiment concerns the failure of the actively rehearsing second graders to reach the recall level of older children who spontaneously rehearsed actively. One possible explanation for this difference in recall might be that the younger children had difficulty in retrieving or generating items to be rehearsed.

In Experiment I, these issues were explored with a procedure designed to minimize the operation of retrieval of items during learning. Three groups of second graders were tested. Control subjects received no particular rehearsal instructions, whereas one experimental group was instructed to rehearse by intermixing several items in an active rehearsal strategy. In these two conditions, items were visually presented one after the other. The second experimental group was similarly instructed, but the method of presentation was modified such that all items remained visible after initial presentation. Here, subjects did not have to generate or retrieve the to-be-rehearsed items; the role of the retrieval was minimized under these conditions. Two groups of sixth graders received "active" rehearsal instructions, with items either remaining visible or not after presentation. All subjects were given 18 unrelated words on each of four alternating rehearsal and recall trials.

The results of this experiment are shown in the next slide. A rehearsal

- - - - - - - -

slide 4

- - - - - - - -

measure--the number of different words rehearsed together in one sample rehearsal set--is shown in the first column of this table. The recall scores are shown in the second column. Because interest focused upon the recall of more deeply processed items, the recall data are presented as totals with the recall of the last four items (i.e., the recency effect) excluded. As was the

case with the Ornstein, Naus, and Stone experiment, the second graders given active rehearsal instructions rehearsed more items together and recalled more than the second graders who were free to rehearse in any way. More importantly, the group of second graders receiving active rehearsal instructions with the words visible was better able to execute the active rehearsal strategy. These children rehearsed still more items together, and enhanced recall resulted. Finally, the item availability manipulation did not significantly affect the performance of the sixth graders.

These data are consistent with the hypothesis that second graders have some difficulty in retrieving items to be rehearsed when they are instructed to rehearse several words together. When these children were given active rehearsal instructions under conditions in which retrieval-for-rehearsal was not required, performance was at approximately the sixth grade level. In addition, the fact that recall could be enhanced in a situation in which active item generation was not required clearly supports the view that such retrieval is not responsible for the recall facilitation typically observed with the joint of rehearsal of several items. Similarly, the fact that sixth grade recall was not disrupted when these older children were prevented from retrieving the items to be rehearsed (under the words visible condition) also supports the view that it is the consequences of active retrieval that are important for recall, and not the item generation process itself.

Experiment II was designed to provide additional information on this retrieval issue using an alternating sort/recall procedure. The use of this task permitted the simultaneous investigation of the relationship between rehearsal activity and the organizational structure of the to-be-remembered material. Third and sixth graders were instructed to rehearse aloud (but with no particular strategy suggested) while they sorted lists into groups.

In one condition, sorting was executed in a spread out (or words visible) fashion, such that all members of the groups remained visible after initial presentation. In a second condition, subjects formed groups in "piles" such that only the most recently placed item in each group was visible (words covered condition). After each sort, subjects were asked to recall the words in any order. To investigate the role of organizational variables, the type of sorting schemes given to the subjects was varied. Subjects were required to sort words according to one of three pre-determined categorization schemes: semantic, story, or random groupings. In the semantic condition, the categories were established on the basis of taxonomic groupings (e.g., pants, shirt, shoe, mitten), whereas in the story condition, the categories were based upon words which combined into a simple imaginable narrative (e.g., mailman, letter, dog, pants). In contrast to the cohesive categories in these two conditions, words in the random condition were assigned to categories such that interitem associations were minimized (e.g., house, pants, lion, egg). All subjects were given 19 words to group into five categories of varying size, and sorting was carried out until a criterion of 90% correct or 7 trials was reached.

The sorting data were analyzed separately for those children who did and did not reach the sorting criterion during the seven allotted trials. Subjects in every group but one were able to reach the criterion of consistent sorting. Of those subjects who sorted according to a random scheme with the words covered, 50% of the third graders, and 30% of the sixth graders did not reach criterion. Of those who reached criterion, the third graders took 4.0 trials, while the sixth graders required 3.6 trials. Collapsing across grade and item availability, the semantic, story, and random groups required 2.3, 3.6, and 5.9 trials, respectively, to reach criterion.

Further, the words covered conditions required an average of 4.0 trials and the words visible conditions an average of 3.7 trials.

At this time we will concern ourselves with two categories of rehearsal and recall performance: that demonstrated before the sorting criterion was reached, and then again on the final criterion trial. For those children who reached criterion, all trials preceding the criterion trial are included in these analyses, whereas for children not reaching criterion sorting, all 7 trials are considered to represent acquisition performance. Precriterion rehearsal and recall performance are indicated in the next slide.

- - - - - - - -

Slide 5

- - - - - - - -

Three general trends are apparent in these data. First, third graders tended to rehearse less actively and recall less well than did the sixth graders. A second finding was that the third graders rehearsed more actively when the items were visible and recall improved under these conditions. At the sixth grade level, with the exception of one group, the effect of this item availability manipulation was not as striking. A third point reflects a general effect of organizational scheme. Recall and rehearsal tended to be higher under conditions of semantic and story groupings, as compared with the random sorting conditions. An interesting exception can be seen in the performance of sixth graders given random sorting schemes. When the to-be-remembered items were kept visible during learning, these words were rehearsed more actively than the semantically constrained and narrative story items, and the recall of these materials actually exceeded that of the more structured lists.

These data suggest the following conclusions: (1) The rehearsal and

recall facilitation of the third graders under conditions in which the words remained visible suggest, as in Experiment I, that the practicing of several items together leads to enhanced recall regardless of whether or not subjects generate the rehearsed items themselves. The fact that the sixth graders' recall was not diminished under conditions of word visibility is also consistent with this conclusion. (2) Third grade children were able to use the organizational information present in the word groupings to structure their rehearsal and thus perform more efficiently. (3) The dramatic increase in both rehearsal and recall performance for the sixth grade group given random sorting schemes with the words visible suggests that these children utilize their knowledge of the difference between randomly created categories and those with a more cohesive structure to differentially modify their rehearsal strategy. Further, these data are consistent with the view that active rehearsal--perhaps leading to the generation of an organizational plan--is more necessary when items are randomly assigned to categories than when the category structure is highly salient.

These findings are consistent with other experiments by Ornstein, Naus, and Liberty, and Ornstein, Naus, and Miller, which suggest that active rehearsal facilitates recall during list acquisition primarily because it helps in establishing an organizational structure. Further, if it is the case that rehearsal serves to generate an organization of the to-be-remembered items, then it might be expected that the effects of rehearsal would be most clearly visible while that organizational structure is being created. Thus, during the pre-criterion trials one would expect to observe a direct relationship between rehearsal activity and recall. In contrast, if rehearsal activity assists in the imposition of an organization, the effects of such rehearsal should no longer be observed once an organization has been imposed.

Recall should be determined primarily by the organization established, no matter how that organizational scheme developed. Thus, in the present experiment one might expect that the relationship between recall and rehearsal would be negligible on the criterion trial. The criterion trial rehearsal and recall data of those subjects who reached the sorting criterion in Experiment II address this issue. The children who did not reach criterion were not included in this analysis.

The final slide presents the mean number of different items rehearsed

- - - - - - - -

slide 6

- - - - - - - -

together, averaged across serial position, for the final trial performance of the subjects who reached criterion. As can be seen, the third graders rehearsed fewer items together than the older subjects. Also, children in the words visible conditions rehearsed more actively than did children who only had one item per group visible. Finally, rehearsal activity varied with the type of organization which was being acquired; in general, more active rehearsal was observed when subjects were learning organized materials. Again, an exception to this was for the sixth graders presented with random sorting schemes in the words visible condition. In general, the rehearsal data resemble the acquisition data illustrated previously. The recall data, however, are particularly interesting. As can also be seen from this slide, recall performance is equivalent once subjects reach a criterion of consistent grouping; this finding was obtained regardless of age of subject, rehearsal technique used while the criterion was being approached, and organization of the stimulus items, i.e., semantic, story, or random. These findings thus are consistent with the view that active rehearsal may assist

in the imposition of an organization, and that once this structure is attained, recall is constant regardless of the age of the subject.

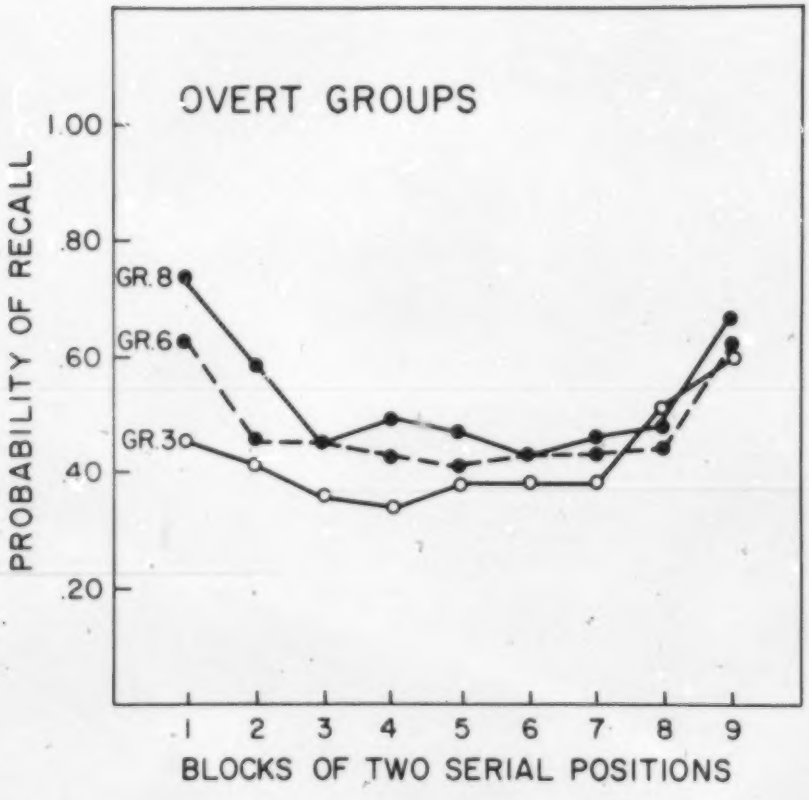
The findings of these two experiments speak to several issues. Given that rehearsal and recall were facilitated when subject-generated retrieval of items was not necessary, retrieval does not appear to be an important component of active rehearsal. Further, three findings are consistent with the view that the operation of rehearsal is strongly influenced by organizational factors and may serve an organization-generating function. First, rehearsal activity and pre-criterion recall varied with sorting pattern. Second, sixth graders used item availability to rehearse randomly grouped items very actively, perhaps generating some type of organization which was not implicit in the material. Third, the absence of post-criterion recall differences suggests that rehearsal assists in the imposition of structure upon the material; once such structure is attained, recall is relatively constant.

References

Ornstein, P. A., Naus, M. J., & Liberty, C. Rehearsal and organizational processes in children's memory. Child Development, 1975, 46, 818-830.

Ornstein, P. A., Naus, M. J., & Miller, T. D. The effects of list organization and rehearsal activity on children's free recall. Child Development, 1977, 48, 292-295.

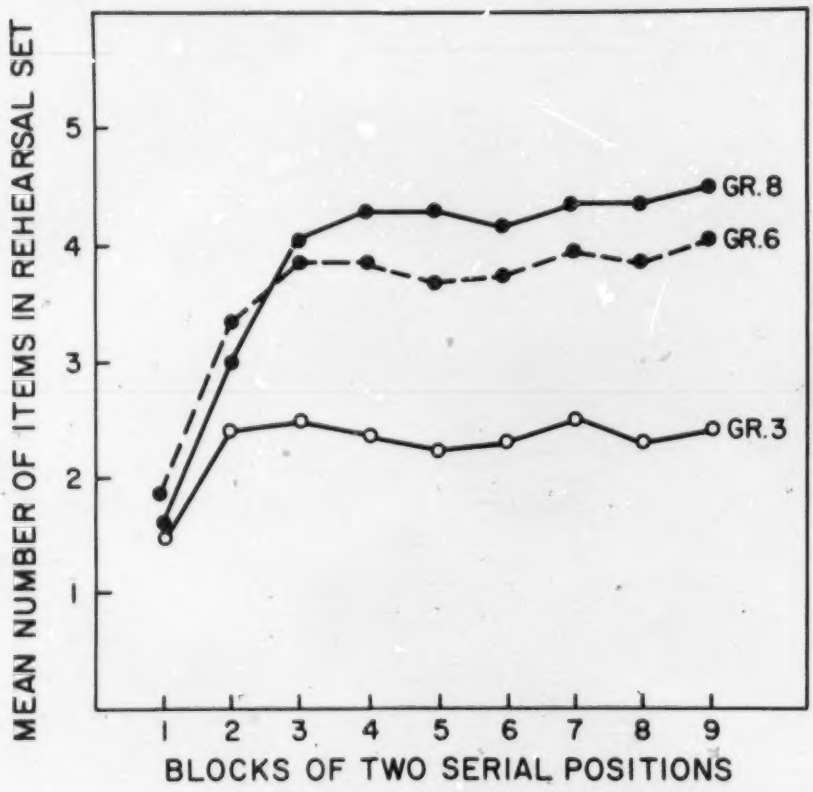
Ornstein, P. A., Naus, M. J., & Stone, B. P. Rehearsal training and developmental differences in memory. Developmental Psychology, 1977, 13, 15-24.


OVERT GROUPS
PROBABILITY OF RECALL
1.00
.80
.60
.40
.20
GR. 8
GR. 6
GR. 3
1
2
3
4
5
6
7
8
9
BLOCKS OF TWO SERIAL POSITIONS

TYPICAL REHEARSAL PROTOCOLS

Word Presented	Eighth Grade Subject	Third Grade Subject
1. Yard	Yard, Yard, Yard	Yard, Yard, Yard, Yard, Yard
2. Cat	Cat, Yard, Yard, Cat	Cat, Cat, Cat, Cat, Yard
3. Man	Man, Cat, Yard, Man, Yard, Cat	Man, Man, Man, Man, Man,
4. Desk	Desk, Man, Yard, Cat, Man Desk, Cat, Yard	Desk, Desk, Desk, Desk

Ornstein, Naus, and Liberty (1975)


MEAN NUMBER OF ITEMS IN REHEARSAL SET
5
4
3
2
1
GR. 8
GR. 6
GR. 3
1 2 3 4 5 6 7 8 9
BLOCKS OF TWO SERIAL POSITIONS

MEAN NUMBER OF ITEMS REHEARSED TOGETHER (AT ASYMPTOTE) AND MEAN PROBABILITY OF RECALL (MINUS LAST 4 SERIAL POSITIONS) FOR SECOND AND SIXTH GRADERS

GROUP	ITEMS REHEARSED	RECALL PROBABILITY
Second grade/spontaneous, words covered	1.0	.24
Second grade/many-item, words covered	3.4	.30
Second grade/many-item, words visible	5.8	.45
Sixth grade/many-item, words covered	4.9	.49
Sixth grade/many-item, words visible	4.9	.53

MEAN NUMBER OF ITEMS REHEARSED TOGETHER AND THE MEAN PROBABILITY OF RECALL ON ACQUISITION TRIALS

THIRD GRADE		
WORDS COVERED CONDITIONS	ITEMS REHEARSED	RECALL PROBABILITY
SEMANTIC	2.45	.55
STORY	2.30	.54
RANDOM	1.70	.40
WORDS VISIBLE CONDITIONS		
SEMANTIC	3.00	.68
STORY	2.94	.65
RANDOM	2.47	.54
SIXTH GRADE		
WORDS COVERED CONDITIONS		
SEMANTIC	3.86	.73
STORY	4.06	.79
RANDOM	3.33	.65
WORDS VISIBLE CONDITIONS		
SEMANTIC	3.84	.71
STORY	4.66	.83
RANDOM	7.01	.88

MEAN NUMBER OF ITEMS REHEARSED TOGETHER AND THE MEAN PROBABILITY OF RECALL ON THE CRITERION TRIAL

THIRD GRADE		
WORDS COVERED CONDITIONS	ITEMS REHEARSED	RECALL PROBABILITY
SEMANTIC	2.40	.95
STORY	2.31	.95
RANDOM	1.73	.92
WORDS VISIBLE CONDITIONS		
SEMANTIC	3.00	.94
STORY	2.90	.93
RANDOM	2.50	.95
SIXTH GRADE		
WORDS COVERED CONDITIONS		
SEMANTIC	3.85	.93
STORY	4.10	.92
RANDOM	3.35	.94
WORDS VISIBLE CONDITIONS		
SEMANTIC	3.90	.94
STORY	4.61	.92
RANDOM	7.00	.93